I03098-WO

CLAIMS

1. A method for reducing combustion residues in exhaust gases generated from the combustion of a fuel, comprising treating the exhaust gases before releasing them in the environment,

characterized in that

said treating the exhaust gases comprises performing a post-combustion process by submitting the exhaust gases to radiant energy in a radiant combustion reactor **(125)**, so as to increase a temperature of the exhaust gases to a value sufficient to cause self-combustion.

2. The method according to claim 1, in which within the radiant combustion reactor the temperature of the exhaust gases is increased to a value in the range from approximately 400 °C to approximately 1400 °C, preferably from approximately 900 °C to approximately 1200 °C and, even more preferably, from approximately 900 °C to approximately 1100 °C.

3. The method according to claim 1 or 2, further comprising submitting the exhaust gases to filtering **(130a,130b)** so as to substantially eliminate residual uncombusted dust and particulate material present in the exhaust gases, said filtering being performed at least after the post-combustion.

4. The method according to claim 3, in which said post-combustion process is carried out in at least two stages, the method comprising submitting the exhaust gases to said filtering also between the two stages.

I03098-WO

5. The method according to claim 3 or 4, in which said filtering is an active filtering.

6. The method according to any one of the preceding claims, further comprising pre-heating (**120**) the exhaust gases before performing the post-combustion process.

7. The method according to claim 6 when depending on claim 2, in which said pre-heating the exhaust gases comprises bringing a temperature of the exhaust gases over approximately 400 °C, preferably in the range from approximately 400 °C to approximately 700 °C.

8. The method according to claim 7, in which said pre-heating the exhaust gases comprises accelerating and compressing (**123,121**) the exhaust gases.

9. The method according to any one of the preceding claims, further comprising lowering a temperature (**135**) of the exhaust gases after performing the post-combustion process before releasing the post-combusted exhaust gases in the environment.

10. The method according to claim 9, in which the temperature of the post-combusted exhaust gases is lowered to a value in the range from approximately 100 °C to approximately 150 °C.

11. The method according to claim 9 or 10 as depending on claim 3, in which said lowering the temperature of the post-combusted exhaust gases is performed after said filtering.

I03098-WO

12. The method according to any one of claims 9, 10 or 11 as depending on claim 6, in which said lowering the temperature of the exhaust gases comprises exploiting a heat released by the post-combusted exhaust gases for pre-heating of the exhaust gases to be post-combusted.

13. The method according to any one of the preceding claims, in which the post-combustion process is carried out continuously, with the exhaust gases to be submitted to post-combustion being in substantially contiguity relationship with the post-combusted exhaust gases within the radiant combustion reactor.

14. The method according to any one of claims 1 to 12, in which the post-combustion process is carried out partially continuously, with the exhaust gases to be submitted to post-combustion being separated from the post-combusted exhaust gases within the radiant combustion reactor of a time of the order of 10^6 seconds.

15. The method according to any one of claims 1 to 12, in which the post-combustion process is carried out discontinuously, with the exhaust gases already submitted to post-combustion being kept substantially separated from the exhaust gases to be submitted to post-combustion.

16. An apparatus **(100)** for reducing combustion residues, particularly pollutants, in exhaust gases generated from the combustion of a fuel, comprising means for treating the exhaust gases before releasing them in the environment,

characterized in that

said treating means comprise a radiant combustion

reactor (125) wherein the exhaust gases are caused to pass through, so as to be submitted to radiant energy for increasing a temperature of the exhaust gases to a value sufficient to cause self-combustion, thereby a post-combustion process of the exhaust gases is performed before releasing them in the environment.

17. The apparatus according to claim 16, in which within the radiant combustion reactor the temperature of the exhaust gases is increased to a value in the range from approximately 400 °C to approximately 1400 °C, preferably from approximately 900 °C to approximately 1200 °C, more preferably from approximately 900 °C to approximately 1100 °C.

18. The apparatus according to claim 16 or 17, further comprising filtering means (**130a,130b**) adapted to substantially eliminate residual uncombusted dust and particulate material present in the exhaust gases, said filtering means (**130b**) being arranged at least downstream the radiant combustion reactor.

19. The apparatus according to claim 18, in which said radiant combustion reactor comprises at least two chambers, one downstream the other, the filtering means (**130a**) being additionally arranged between the two chambers.

20. The apparatus according to claim 18 or 19, in which the filtering means comprise active filters, particularly selective filters based on ceramic and zeolite materials.

21. The apparatus according to any one of claims 16 to 20, further comprising a pre-heating chamber (**120**), upstream

the radiant combustion reactor, for pre-heating the exhaust gases before performing the post-combustion process.

22. The apparatus according to claim 21 when depending on claim 17, in which in said pre-heating chamber the exhaust gases are pre-heated to a temperature over approximately 400 °C, preferably in the range from approximately 400 °C to approximately 700 °C.

23. The apparatus according to claim 21, in which said pre-heating chamber includes means (**121**) for accelerating and compressing the exhaust gases, particularly one or more among a fan or an arrangement of fans, a turbine, a turbocompressor.

24. The apparatus according to claim 23, in which said pre-heating chamber further comprises a Venturi tube (**123**) for further accelerating the exhaust gases.

25. The apparatus according to any one of claims 16 to 24, further comprising a heat-exchange arrangement (**135**) downstream the radiant combustion reactor, for lowering a temperature of the exhaust gases after performing the post-combustion process before releasing the post-combusted exhaust gases in the environment.

26. The apparatus according to claim 25, in which the heat-exchange arrangement is adapted to lowering the temperature of the post-combusted exhaust gases to a value in the range from approximately 100 °C to approximately 150 °C.

27. The apparatus according to claim 25 or 26 as

depending on claim 18, in which said heat-exchange arrangement is placed downstream said filtering means.

28. The apparatus according to any one of claims 25, 26 or 27 as depending on claim 21, in which said heat-exchange arrangement is operatively coupled to the pre-heating chamber, so that a heat released by the post-combusted exhaust gases in the heat-exchange arrangement is exploited for the pre-heating the exhaust gases in the pre-heating chamber.

29. The apparatus according to any one of claims 16 to 28, further comprising a control unit (**140**), particularly an electronic, programmable control unit, for controlling the post-combustion process.

30. The apparatus according to any one of claims 16 to 29, in which the radiant combustion chamber comprises an enclosed path for the exhaust gases, and heating means associated with the enclosed path for heating walls thereof.

31. The apparatus according to claim 30, in which said heating means comprise Joule-effect heaters (**305a,305b;405a,405c,405d;505a-d;607;707;810;910a,b**).

32. The apparatus according to claim 31, in which said enclosed path comprises an arrangement of ducts (**300;400;500;600;700;800**) comprising at least one duct for the passage of the exhaust gases, and having associated therewith electrical resistors for heating the duct walls.

33. The apparatus according to claim 32, in which said arrangement of ducts comprises at least one among a

substantially "U"-shaped (**300**), a substantially double "U"-shaped (**400**) or a substantially "W"-shaped (**500**) arrangement of ducts, at least one of said ducts having wound around it at least one spiral resistor controllably powered for heating the duct walls.

34. The apparatus according to claim 31, comprising an arrangement of ducts associated with at least one heat radiating panel (**605a,605b;705a**), having embedded therewith a Joule-effect heat generator (**607;707**).

35. The apparatus according to claim 30, in which said heating means comprises an optical radiation source (**1020;1120;1220;1320**), particularly a laser.

36. The apparatus according to claim 35, in which said optical radiation source comprises at least one laser.

37. The apparatus according to claim 36, in which said at least one laser is operated in pulsed mode.

38. The apparatus according to claim 36 or 37, further comprising optical radiation reflecting/deflecting means (**1007;1105;1200a**) for reflecting/deflecting the optical radiation onto the enclosed path.

39. The apparatus according to any one of claims 16 to 38, in which means (**1405;1505;1605**) are provided within the radiant combustion reactor for determining a separation of different parts of the exhaust gases undergoing different phases of the post-combustion process.

40. The apparatus according to claim 39, in which said

means comprise a rotor rotatably arranged inside the radiant combustion reactor.

41. A system comprising a fuel combustion apparatus (**105**) in which a combustion process of a fuel takes place, and an apparatus (**100**) for treating exhaust gases originating from the combustion process, wherein said apparatus for treating the exhaust gases is realized according to any one of the claims 16 to 40.

42. The system according to claim 41, in which said fuel combustion apparatus is an internal combustion engine, particularly a vehicle engine.

43. The system according to claim 41, in which said fuel combustion apparatus is a burner of a heating system.